EXHIBIT 7

Encyclopedia of Networking, Electronic Edition

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of messages to ensure that the messages eventually reach their destination. MSMQ provides guaranteed message delivery, efficient routing, security, and priority-based messaging.

RELATED ENTRIES Database Connectivity; DCE (Distributed Computing Environment), The Open Group; Middleware and Messaging; RPC (Remote Procedure Call); Sockets API; *and* WinSock

APPC (Advanced Program-to-Program Communications)

APPC, along with APPN (Advanced Peer-to-Peer Networking) and CPI-C (Common Programming Interface for Communications), are networking technologies that are available on many different IBM and non-IBM computing platforms. APPC, also known as LU 6.2, is software that enables high-speed communications between programs on different computers, from portables and workstations to midrange and host computers over SNA, Ethernet, X.25, token ring, and other network topologies. APPC software is available for many different systems, either as part of the operating system or as a separate software package. It is an open and published communications protocol.

APPC represented a major strategy change for IBM when it was introduced. It demonstrated a shift in network control away from the centralized host systems to the systems that were attached to the network. Systems running LU 6.2 sessions do not need the services of a host system when establishing sessions.

LU 6.2 was developed to allow computers on the network with their own processing power to set up their own sessions. In the older hierarchical approach, terminals attached to host computers relied completely on the host to set up and maintain sessions. LU 6.2 provides peer-to-peer communications between systems other than hosts and allows those systems to run distributed applications like file sharing and remote access. The entire range of IBM platforms is supported by LU 6.2, including LANs, desktop systems, and mainframes.

LU 6.2 relies on SNA (Systems Network Architecture) Type 2.1 nodes. Type 2.1 nodes are different than other SNA nodes in that they run CP (Control Point) software that allows them to engage in peer-to-peer connections with other Type 2.1 nodes. This arrangement became increasingly important as LANs were installed in IBM SNA environments. While the LAN provided a connection from a network node to a connected host, those LAN nodes could also use LU 6.2 to communicate directly with other LAN nodes rather than go through the host.

Applications using the LU 6.2 protocols are called *TPs (transaction programs)*. Examples of TPs are IBM DDM (Distributed Data Management), which provides file sharing and database sharing among systems that implement DDM and DIA (Document Interchange Architecture), which is a document exchange standard that defines searching, browsing, printing, and the distribution of documents.

A TP opens a session, performs data transfers, and closes. A TP performs a "unit of work" on a channel that interconnects IBM systems. The sessions are designed to be

short-lived because some systems cannot perform other tasks until they complete the transactions. A transaction is like a conversation, and a TP can hold multiple conversations with multiple systems. Each conversation has a name and buffers for sending and receiving data, along with a code that is returned to indicate success or failure of the transaction. The parameters are simple, so code can be portable among systems.

Programs use LU 6.2 services through an interface called the LU 6.2 Protocol Boundary or through the CPI-C (Common Programming Interface for Communications). CPI-C is the current preferred method. CPI provides a common environment for the execution of programs on different IBM platforms, and the C version provides the LU 6.2 communication interface. Recently, IBM has implemented CPI-C in its Open Blueprint, which supports TCP/IP.

RELATED ENTRIES APPN (Advanced Peer-to-Peer Networking); IBM (International Business Machines); SAA (Systems Application Architecture); *and* SNA (Systems Network Architecture)

INFORMATION ON THE INTERNET

IBM APPN information	http://www.networking.ibm.com/app/aiwinfo/aiwintro.htm
General IBM information	http://www.raleigh.ibm.com
IBM networking information	ftp://networking.raleigh.ibm.com

Apple Computer

Apple Computer is the manufacturer of the Macintosh line of computers and developed the AppleTalk networking system that works over LocalTalk, EtherTalk, TokenTalk, and FDDITalk networks. Apple is involved extensively in networking and distributed management. Its products are widespread and can be used as nodes on almost every available network operating system and topology. Its Macintosh System 7 and Mac OS operating systems are in use on Macintosh systems everywhere. In addition, Macintosh users have relied on the AppleTalk networking protocols and AppleShare servers for all their networking needs.

Apple's next generation operating system is called Rhapsody and is due out in late 1997 or early 1998. Rhapsody will implement Internet and multimedia capabilities with a new advanced Mac look and feel. Rhapsody will also incorporate Java support by integrating Java Libraries and a Java VM (Virtual Machine). Rhapsody will also deliver preemptive multitasking, protected memory, and symmetrical multiprocessing capabilities.

The recent merger of Apple and NeXT will produce an interface that has the best features of the Mac OS and the NeXT interface technology, as well as new APIs from which to develop new classes of software products. These APIs are based on NeXT Software Inc.'s OPENSTEP development environment.

RELATED ENTRY Firewall

Application Server

An application server is a server that runs programs in a network environment. The applications may be network versions of commercial, off-the-shelf software that allow multiple users to access and run the program. This avoids loading the program on each user's computer and allows central updates to take place on the server. Custom built or off-the-shelf client-server applications may run on application servers as well. A client-server application distributes processing between the client and the server, with the server handling file and data access and the client handling presentation and user input. A database server is also an application server, but is optimized for disk I/O (input/output) and may include attached servers that contain replicas of the data for fault tolerance.

RELATED ENTRIES Client/Server Computing; Distributed Applications; *and* Servers

Applications, Network

See Distributed Applications.

APPN (Advanced Peer-to-Peer Networking)

APPN was introduced by IBM in 1985 and integrated into SNA (Systems Network Architecture). It provides peer-to-peer networking services similar to but not quite the same as TCP/IP. One of the main reasons IBM introduced APPN was to provide client/server computing services to users who might have moved to TCP/IP or other services. APPN is basically link-layer independent. It can run over token ring, Ethernet, FDDI (Fiber Distributed Data Interface), frame relay, ISDN (Integrated Services Digital Network), X.25, SDLC (Synchronous Data Link Control), and ultra high-speed networks such as B-ISDN and ATM.

APPN is based on the concept that computers on the network have enough processing power of their own to handle session management and routing. APPN moves various services from central control (such as that provided by a host mainframe computer) to decentralized control points that operate in a peer-to-peer relationship. In the old SNA model, a mainframe was required to control sessions. In the APPN model, user stations set up and maintain their own sessions.

APPN is part of IBM's revision to SNA and is often called the "new SNA." APPN is still tightly integrated with SNA, and it uses the SNA LU 6.2 protocol that is formally marketed as APPC (Advanced Program-to-Program Communications). In addition, APPN implements a newer application interface, the CPI-C (Common Programming Interface for Communications). APPN is compared to OSI and TCP/IP in Figure A-6.

OSI	APPN	TCP/IP
Application	Application	Applications and services
Presentation	APPC (LU 6.2) CPI-C	Sockets interface
Session		
Transport	APPN Path Control	TCP
Network		IP
Data link	Data link	Data link
Physical	Physical	Physical

Figure A-6. *APPN architecture*

- **APPC** Introduced in the early 1980s, APPC is also called LU 6.2. It is the application interface for APPN. By providing a way for applications on separate systems to communicate without involving a host system, APPC forged the way for APPN. It provided the shift away from centralized mainframe control and allowed programmable devices like computers to control their own sessions.
- **CPI-C** CPI is a set of APIs that provide a common environment for the execution of programs on different IBM platforms. Recently, IBM has implemented CPI-C in its Networking Blueprint and included support for OSI and TCP/IP protocols.

APPN provides routing services for APPC sessions. The routing environment consists of the following hierarchy as pictured in Figure A-7:

- **ENs (end nodes)** An EN is a computer with its own operating system. It transmits information about itself and any locally attached resources to adjacent NNs (network nodes) when it logs in to the network. The NN then holds this information and provides it to other nodes on the APPN network. This reduces the need to search every EN when establishing sessions. IBM mainframe and midrange computers as well as AIX or UNIX systems and desktop computers running OS/2 are end nodes. These larger systems can also be network nodes, as discussed next.

- **NNs (network nodes)** An NN is a routing node that moves traffic between end nodes. NNs exchange routing information about the topology of the network with other NNs as changes occur. To conserve network bandwidth, only information about recent changes is exchanged, rather than entire routing tables. NNs also locate resources and store the resource information for later use. Thus, NNs serve as distributed depositories for information about the network. This caching feature "improves with age" as more routes are added to the list, reducing the number of required route searches. IBM AS/400 minicomputers, IBM 6611 routers, and 3174 terminal controllers are devices that can serve as NNs.
- **CNN (composite network node)** A CNN provides seamless communications between an SNA subarea and APPN. The subarea network, which may contain a VTAM (Virtual Telecommunication Access Method) node and any number of NCP (Network Control Program) nodes, emulates an NN. Note that VTAM provides users with access to network resources and information, and NCP is the control program that runs in an IBM FEP (front-end processor) such as an IBM 3745.
- **LENs (low-entry nodes)** A LEN can participate in a session with another LEN node on the network, but it requires the services of a network node to do so. This network node can be part of a local area network or directly connected to the LEN. PCs running DOS are examples of LEN nodes because they don't have the capability of operating as end nodes. OS/2, on the other hand, has full end-node capabilities.
- **BN (border node) and EBN (extended border node)** Subdivision of an APPN network is possible if a network broadcast becomes excessive. Division of the network isolates a broadcast to specific subnetworks. The BN or EBN routes information among subnetworks.

APPN NNs dynamically locate resources on the network and store the routing information locally. In older SNA networks, network elements were defined in a VTAM table stored in a mainframe. In contrast, APPN networks can configure themselves using route discovery methods. Network nodes work together to establish a path through a network so two end stations can set up a communication session. Each node contains a routing table used to establish the pathway for the link. One potential problem with APPN is that the selected path remains fixed for the duration of the session. If a node fails along the path, the session is not rerouted and fails as well. IBM fixed this with HPR (High-Performance Routing), which was introduced in late 1994. You can refer to "HPR (High-Performance Routing)" for more information.

Applications establish sessions with other destination nodes on the network by accessing logical unit software interfaces that correspond roughly to OSI session layer protocols. These high-level interfaces provide names for software entities that reside in ENs and NNs on the network. Note that applications go through LUs (logical units) to establish sessions, not directly to APPN. Basically, an LU in one station uses APPN

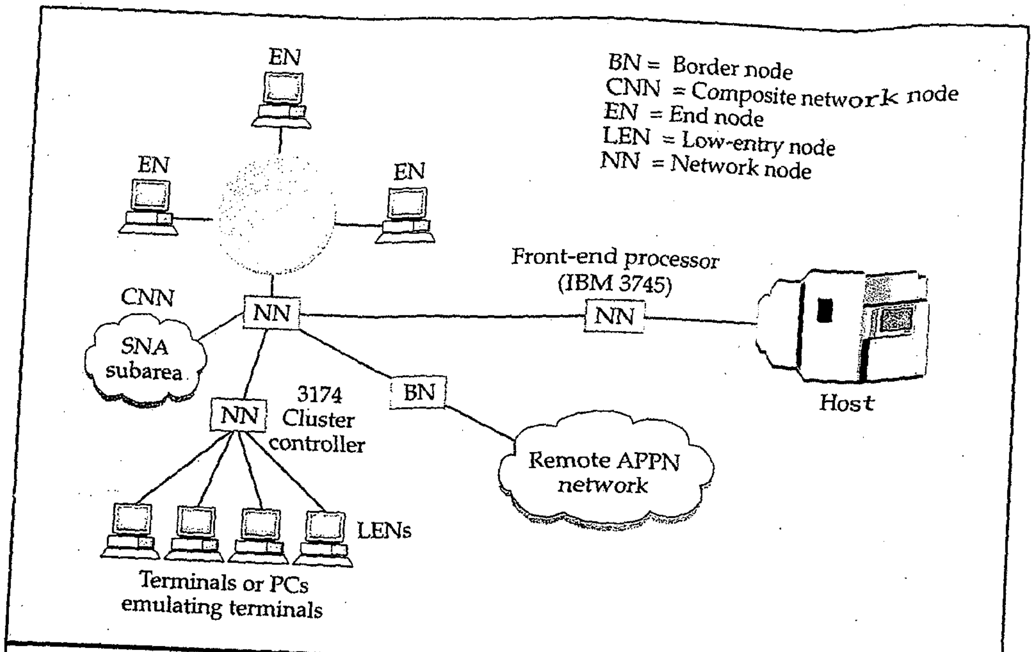

Figure A-7. *APPN routing environment*

services to locate a destination LU and set up a session. Think of LU sessions as pipes transmitting data across the network from one application to another. Multiple applications can access a single LU, or applications can access multiple LUs.

The Future

The future of APPN is in question. TCP/IP networks have proliferated in many organizations. However, SNA protocols are not routable and APPN and TCP/IP do not mix. So network designers have a problem. They can build two networks or look for a solution that takes advantage of the internetworking features of TCP/IP to transport SNA traffic throughout the enterprise. A vendor consortium called the APPN Implementers Workshop is working to integrate TCP/IP and APPN. A protocol called DLSw (Data Link Switching) is based on its standards. It provides a way to move SNA traffic over TCP/IP networks by encapsulating the traffic into TCP/IP packets. The IETF (Internet Engineering Task Force) has also been working on DLSw.

Basically, DLSw provides a way for routers to route "unroutable" SNA traffic (and NetBIOS sessions) across an internetwork. The technique is to link the two SNA or NetBIOS systems with a pair of DLSw routers. The routers then take all traffic that is destined for the other SNA system, encapsulate it, and send it across the internetwork.

An even more intriguing solution is the World Wide Web model of Web browsers and servers. Many organizations are building intranets that take advantage of Web technologies to give users of any operating system access to information on internal servers. Web technology can also provide a way to get at mainframe data as well. New methods for accessing SNA systems using Web browsers over TCP/IP networks are emerging, such as Cisco Systems' IOS/390 TCP/IP intranet software. IOS is Cisco's Internetwork Operating System.

Browser-based access is especially attractive to remote and mobile users who make temporary connections into the corporate network. The best way for them to do that is through a single Web-based interface that gives them access to all the corporate information systems.

In general, SNA traffic on enterprise networks and on WANs will no doubt decrease significantly over the next few years as new methods for accessing traditional IBM systems take hold.

RELATED ENTRIES APPC (Advanced Program-to-Program Communications); DLSw (Data Link Switching); HPR (High-Performance Routing), IBM; SAA (Systems Application Architecture); *and* SNA (Systems Network Architecture)

Archiving of Data

See Data Protection.

ARCNET

The ARCNET (Attached Resource Computing Network) is a baseband, token-passing network system that offers flexible star and bus topologies at a low price. Transmission speeds are 2.5 Mbits/sec. ARCNET uses a token-passing protocol on a token bus network topology. ARCNET is showing its age and is no longer sold by major vendors. However, ARCNET networks still exist in many small offices.

A typical ARCNET configuration is shown in Figure A-8. Although ARCNET is generally considered to have a slow throughput, it does support cable lengths of up to 610 meters when using active hubs. It is suitable for office environments that use text-based applications and where users don't often access the file server.

ARCNET connections are made to *active* and *passive* hubs. An active hub is a network relay that conditions and amplifies the signal strength. Most active hubs have eight ports to which workstations, passive hubs, or additional active hubs can be attached.